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## PHILADELPHIA LIFE TABLES.

BY PLINY EARLE CHASE.

More than forty years ago Dr. Gouverneur Emerson, in the *American Journal of the Medical Sciences*, began his discussion of the vital statistics of Philadelphia.\* His connection with the Board of Health gave him ready access to the original returns, and after subjecting them to a rigid scrutiny, he became satisfied that the sanitary condition of the city was remarkably good.

Doctors W. S. W. Ruschenberger, Wilson Jewell, James N. Corse and W. Lehman Wells, on behalf of the Committee on Epidemics and Meteorology, of the Philadelphia College of Physicians, subsequently published some interesting local nozological tables and conclusions. I cannot find that any other noteworthy use has been made of a valuable mortuary record, which has been kept with great care, and without interruption, from the commencement of the year 1807 until the present time.†

At the request of the Provident Life and Trust Company of Philadelphia, I have recently computed two comparative life tables, from the

\* Among the results developed by Dr. Emerson's investigations connected with the movement of population and vital statistics of Philadelphia, embracing a period of about thirty years from the year 1807, when the first official Bill of Mortality was issued, are the following:

1. Great healthfulness of the city proper, in which the annual proportion of deaths to the population was only 1 in 56 (See *Am. Med. Journal* for Nov. 1827).

2. Excessive mortality in the colored population (*Ibid*).

3. Improved condition of colored population as indicated by reduction of mortality.

4. Excessive mortality of children in the warm months, and demonstration of the fact that the deleterious operations of heat are almost entirely confined to the first months of life, the influence of the seasons upon infantile mortality being scarcely perceptible after the first year of life has passed.

5. The excessive mortality of male over that of female children in the first stages of infancy, and demonstration that this is not owing, as commonly supposed—to greater exposure of male children to accidents, but to diseases and physiological causes peculiar to each sex (*Am. Jour. of Med. Sciences*, 1827 to 1831).

7. Practical conclusions drawn from results last mentioned (*Ibid*).

8. Seasons when most births take place (*Ibid*. Nov., 1845).

9. Influence exerted through epidemic cholera and other depressing agencies, tending to reduce the preponderance of male births (*Same Journal* for July, 1848, p. 78).

† "From authority vested in the Board of Health, this municipal power makes it obligatory upon physicians to give certificates designating the name, age, and sex of all who die under their care, and sextons are bound by still heavier penalties not to permit the interment of any dead body until such certificate is obtained, which he returns to the Health Office on the last day of every week, for publication" (Emerson; *op. cit.*, vol. I, p. 117).

returns of the Board of Health, and of the several monthly meetings of the Society of Friends in the city and its immediate neighborhood.

The general Philadelphia table is more extensive than any table hitherto published for a single locality, being based upon records of 425,502 interments, 265,590 births, and seven successive decennial census enumerations.

The Friends' table is based upon records of 14,666 interments, 4,264 births, and eight enumerations of membership. This is the first table ever published that affords any basis for estimating the sanitary advantages of moderation, temperance, and a general regard for the laws of health and morality. The tables which have been constructed from the experience of different Tontines and Life Insurance Companies exhibit some of these advantages, with the added indeterminate advantage of medical selection.

The following definitions and explanations may facilitate the study of the tables :

The *possible life*, is the limit which is sometimes attained in a given district.

The *probable life* ("vie probable"), is the term at which one half of those who are born alive will have died. It is the age, the probability of living beyond which is as great as that of dying before the age is attained.

The *probable life at any age*, is the term at which one half of those who are living at that age will have died.

The *expectation of life* ("vie moyenne"), is the average age which will be attained by all who are born.

The *expectation of life at any age*, is the average after life-time of all who are living at that age.

The *mean expectation* is the average after life-time of all who are living.

The *proportionate mortality* at any age, is the ratio of the number dying during the year following that age to the number living at the precise age.

The *vitality* at any age, is in inverse ratio to the proportionate mortality at that age. If, for example, out of 1000 children born alive the average number of deaths under 1 year of age is 180.38, the proportionate mortality per 1000 is 180.38, and the vitality is  $\frac{1000.00}{180.38}$  or 5.54.

Neither the *mean age at death* nor the *mean age of the living* furnishes a sufficient clue to the expectation of life, or any independent criterion of salubrity. Emigration, immigration, excess of births over deaths or of deaths over births, zymotic diseases, and other circumstances, variously disturb the normal values which are embraced in a perfect life table. Such a table represents an ideal stationary population, or one in which the number of annual births is exactly equal to the number of annual deaths, and one which is not affected by emigration or immigration.

By a joint examination, in accordance with the formulas of De Morgan, Davies and Farr, of the numbers living at any given age and the numbers dying at the same age, the disturbances to which all populations are subject can be mostly eliminated, and results obtained which will afford a proper basis for comparisons.

There are, however, some elements of uncertainty which cannot be removed by any method hitherto proposed. Among these are the following :

1. The old and still mooted doctrine of climacterics, or critical periods of life in which some great constitutional change is supposed to take place, appears to derive some confirmation from such irregularities as the alternate diminution and increase of proportionate mortality, in the Carlisle table, at the ages 21, 22, 31, 33, 46, 50, 89, 90, as well as from the increase of expectation, in the Carlisle table from 91 to 95, in Quetelet's Belgian table from 89 to 91, and in the Philadelphia table from 91 to 100.

2. Wherever a population is affected by immigration, two classes of disturbance may be looked for; one arising from the poorer class of immigrants, who live in the most unhealthy neighborhoods, exposed to privations and hazards which increase the mortality of infancy and youth; the other from a better class, like our house servants, the agents of importing houses, and persons of some property, who increase the average vitality towards the close of life.

3. In many places, especially in cities, almshouses and asylums for the aged furnish comforts which tend to prolong life. The tendency is aided by the freedom from care and anxiety, the infrequency of exhausting mental effort, and the watchfulness of friends or nurses.

4. In a Society with birthright membership, like the Society of Friends, nearly all the deaths in infancy and youth may be entered on the records. But after reaching maturity the ties of membership are often sundered for various reasons, and many of the deaths in old age may escape notice. The ratios of apparent mortality will thus be affected unfavorably, during the whole course of life.

According to the census of 1860, the foreign-born residents of Philadelphia constituted nearly thirty per cent. of the entire population. On this account any comparisons with other life-tables either in infancy or old age might convey an erroneous impression. But the mean expectation is probably but little affected by the foreign element, and it may very properly be considered in the following comparison with two of the most celebrated and one of the most unfavorable foreign tables.

Comparative mean expectations :

Price's London.....	23.70 years.
Philadelphia.....	31.46 "
Farr's English, No. 3, male.....	31.77 "
" " " female.....	32.33 "
Carlisle.....	32.66 "
Friends' .....	33.11 "

Notwithstanding the increased juvenile mortality consequent upon immigration, the Philadelphia table shows a possible life of 114, a probable life of 33.44, and an expectation of 35.09. I know no other city of much magnitude in which so favorable vital conditions have ever been reported.

In preparing the Philadelphia table the following values were ascertained :

Ratio of deaths of colored persons to entire number of	
deaths ; for 62 years.....	8.7 per cent.
Do. from 1863 to 1867, inclusive.....	6.7 “
Average mortality, 62 years.....	1 in 47.836.
“ Colored mortality, 62 years.....	1 in 27.766.
“ “ “ 1858 to 1862, inclusive.....	1 in 34.780.
Ratio of still-births to total births.....	4.3 per cent.
“ “ “ “ deaths.....	5.8 “
“ “ living births to population.....	2.8 “
“ “ deaths to births.....	74.5 “
Natural annual increase.....	$\frac{5}{7}$ “
Average “ “.....	3.3 “
“ “ immigration.....	2.6 “
Mean age at death.....	23.57 years.
“ “ of the living.....	24.29 “

Dr. Emerson's discussions showed a ratio of deaths of colored persons, as great as 16 per cent. of the entire number of deaths ; an average white mortality varying between 1 in 38.25 and 1 in 56.53 ; an average colored mortality of 1 in 19 from 1807 to 1820 inclusive, and of 1 in 27.2 from 1821 to 1830 inclusive. We have no means of determining the ratio of colored mortality since the close of the war, but even if it should show a temporary increase, there can be little doubt that the general sanitary improvement noted by Dr. Emerson still continues. The diminution in the per centage of colored deaths, from 16 per cent. to 6.7 per cent., is attributable in part to this general improvement, and in part to the preponderating increase of the white population.

The advantages of regular habits are shown by the following comparisons :

	<i>Friends.</i>	<i>Philadelphia.</i>	<i>Advantage.</i>
Maximum vitality (age 12).....	310.56	257.74	20.49 per cent.
Average proportionate mortality			
from 20 to 60 years of age.....	14.25	17.58	23.37 “
Expectation of life.....	43.73	35.09	24.62 “
Probable life.....	48.08	33.44	43.78 “
Proportionate mortality at birth...	124.66	180.38	44.70 “

## PHILADELPHIA GENERAL LIFE TABLE.

Age.	Living, Number.	Dying, Number	Propor- tionate Mortality, per 1000.	Expecta- tion, Number of years.	Age.	Living, Number.	Dying, Number	Propor- tionate Mortality, per 1000.	Expecta- tion, Number of years.
0	100,000	18,038	180.38	35.09	58	30,799	891	28.93	15.97
1	81,962	7,540	92.00	41.71	59	29,908	905	30.25	15.43
2	74,422	4,427	59.48	44.88	60	29,003	918	31.65	14.89
3	69,995	2,982	42.60	46.59	61	28,085	931	33.18	14.36
4	67,013	2,039	30.43	47.74	62	27,154	946	34.84	13.84
5	64,974	1,387	21.35	48.23	63	26,208	961	36.66	13.32
6	63,587	943	14.83	48.27	64	25,247	978	38.72	12.81
7	62,644	651	10.40	47.99	65	24,260	996	41.04	12.30
8	61,993	470	7.58	47.49	66	23,273	1,016	43.64	11.81
9	61,523	362	5.88	46.84	67	22,257	1,036	46.55	11.32
10	61,161	297	4.88	46.12	68	21,221	1,055	49.75	10.85
11	60,864	251	4.14	45.34	69	20,166	1,073	53.22	10.39
12	60,613	236	3.88	44.53	70	19,093	1,087	56.94	9.95
13	60,377	238	3.95	43.70	71	18,006	1,096	60.88	9.52
14	60,139	255	4.24	42.87	72	16,910	1,101	65.08	9.11
15	59,884	278	4.64	42.05	73	15,809	1,098	69.48	8.71
16	59,606	307	5.18	41.24	74	14,711	1,090	74.10	8.32
17	59,299	343	5.76	40.45	75	13,621	1,076	78.96	7.94
18	58,956	378	6.40	39.69	76	12,545	1,054	84.06	7.58
19	58,578	414	7.10	38.94	77	11,491	1,028	89.44	7.23
20	58,164	456	7.83	38.21	78	10,463	995	95.14	6.89
21	57,708	493	8.55	37.51	79	9,468	959	101.20	6.57
22	57,215	529	9.24	36.83	80	8,509	916	107.66	6.25
23	56,686	560	9.88	36.17	81	7,593	870	114.56	5.94
24	56,126	587	10.48	35.52	82	6,723	819	121.92	5.65
25	55,539	610	11.00	34.89	83	5,904	767	129.80	5.36
26	54,929	629	11.45	34.28	84	5,137	710	138.18	5.09
27	54,300	643	11.83	33.67	85	4,427	651	147.08	4.82
28	53,657	653	12.18	33.07	86	3,776	591	156.57	4.57
29	53,004	662	12.50	32.47	87	3,185	539	169.20	4.32
30	52,342	672	12.84	31.87	88	2,646	484	183.42	4.10
31	51,670	681	13.18	31.28	89	2,162	439	203.10	3.91
32	50,989	689	13.52	30.69	90	1,723	389	225.54	3.78
33	50,300	698	13.88	30.10	91	1,334	319	239.32	3.63
34	49,602	706	14.24	29.52	92	1,015	247	243.00	3.75
35	48,896	716	14.63	28.94	93	768	187	244.22	3.79
36	48,180	722	15.00	28.36	94	581	142	244.22	3.85
37	47,458	730	15.38	27.79	95	439	107	243.36	3.91
38	46,728	736	15.76	27.22	96	332	80	239.67	4.01
39	45,992	743	16.15	26.64	97	252	59	234.40	4.16
40	45,249	748	16.53	26.07	98	193	43	225.54	4.28
41	44,501	754	16.94	25.50	99	150	31	205.67	4.38
42	43,747	760	17.38	24.93	100	119	23	192.76	4.39
43	42,987	766	17.83	24.36	101	96	18	186.42	4.31
44	42,221	772	18.30	23.79	102	78	14	182.86	4.19
45	41,449	778	18.78	23.23	103	64	12	180.78	4.01
46	40,671	784	19.28	22.66	104	52	9	179.65	3.79
47	39,887	789	19.78	22.10	105	43	8	178.90	3.51
48	39,098	795	20.33	21.54	106	35	6	178.60	3.16
49	38,303	800	20.90	20.97	107	29	5	181.54	2.75
50	37,503	807	21.50	20.41	108	24	6	189.04	2.25
51	36,696	813	22.15	19.85	109	18	6	205.12	1.74
52	35,883	821	22.88	19.28	110	12	5	. .	1.37
53	35,062	830	23.66	18.72	111	7	4	. .	1.05
54	34,232	840	24.54	18.17	112	3	2	. .	.80
55	33,392	851	25.50	17.61	113	1	1	. .	.50
56	32,541	865	26.56	17.06	114				
57	31,676	877	27.70	16.51					

## PHILADELPHIA FRIENDS' LIFE TABLE.

Age.	Living, Number.	Dying, Number	Proportionate Mortality, per 1000.	Expecta- tion. Number of years.	Age.	Living, Number.	Dying, Number	Proportionate Mortality, per 1000.	Expecta- tion. Number of years.
0	10,000	1247	124.66	43 73	58	4,204	96	22.90	16.87
1	8,753	511	58.33	48.89	59	4,108	101	24.45	16.25
2	8,242	272	33.06	50.89	60	4,007	104	26.12	15.64
3	7,970	192	24.08	51.61	61	3,903	109	27.95	15.05
4	7,778	137	17.62	51.87	62	3,794	114	29.90	14.47
5	7,641	99	12.95	51.79	63	3,680	118	32.00	13.90
6	7,542	72	9.55	51.46	64	3,562	122	34.26	13.34
7	7,470	53	7.12	50.95	65	3,440	126	36.72	12.80
8	7,417	40	5.40	50.32	66	3,314	130	39.40	12.27
9	7,377	31	4.25	49.59	67	3,184	135	42.32	11.75
10	7,346	27	3.56	48.80	68	3,049	139	45.50	11.25
11	7,319	23	3.24	47.97	69	2,910	142	48.94	10.76
12	7,296	24	3.22	47.12	70	2,768	146	52.68	10.29
13	7,272	25	3.42	46.27	71	2,622	149	56.70	9.83
14	7,247	27	3.80	45.43	72	2,473	151	61.04	9.39
15	7,220	31	4.28	44.60	73	2,322	152	65.65	8.97
16	7,189	35	4.85	43.79	74	2,170	153	70.58	8.56
17	7,151	39	5.48	43.00	75	2,017	153	75.82	8.18
18	7,115	44	6.18	42.24	76	1,864	152	81.32	7.81
19	7,071	49	6.90	41.50	77	1,712	149	87.10	7.45
20	7,022	54	7.66	40.78	78	1,563	145	93.14	7.12
21	6,968	58	8.38	40.09	79	1,418	141	99.42	6.80
22	6,910	62	9.00	39.43	80	1,277	136	105.96	6.49
23	6,848	66	9.55	38.78	81	1,141	128	112.72	6.20
24	6,782	68	10.00	38.15	82	1,013	122	119.72	5.93
25	6,714	69	10.40	37.53	83	891	113	126.94	5.67
26	6,645	72	10.72	36.92	84	778	104	134.40	5.42
27	6,573	72	11.00	36.31	85	674	96	142.10	5.18
28	6,501	73	11.24	35.71	86	578	87	150.00	4.95
29	6,428	74	11.48	35.11	87	491	77	158.10	4.74
30	6,354	74	11.70	34.51	88	414	69	166.42	4.54
31	6,280	75	11.90	33.92	89	345	61	174.93	4.34
32	6,205	75	12.10	33.32	90	284	52	183.66	4.16
33	6,130	75	12.31	32.72	91	232	44	192.62	3.98
34	6,055	76	12.48	32.12	92	188	38	201.80	3.81
35	5,979	76	12.65	31.52	93	150	32	211.25	3.65
36	5,903	75	12.84	30.92	94	118	26	220.98	3.49
37	5,828	76	13.02	30.32	95	92	21	231.02	3.34
38	5,752	76	13.18	29.71	96	71	17	241.38	3.20
39	5,676	76	13.32	29.10	97	54	14	252.14	3.05
40	5,600	75	13.45	28.49	98	40	10	263.30	2.91
41	5,525	75	13.58	27.87	99	30	9	274.92	2.78
42	5,450	75	13.72	27.25	100	21	6	287.02	2.64
43	5,375	74	13.85	26.62	101	15	4	299.66	2.50
44	5,301	74	14.00	25.99	102	11	4	312.92	2.35
45	5,227	74	14.13	25.36	103	7	2	326.85	2.19
46	5,153	74	14.28	24.71	104	5	2	341.54	2.01
47	5,079	73	14.46	24.06	105	3	1	356.75	1.80
48	5,006	74	14.63	23.40	106	2	1	372.87	1.52
49	4,932	73	14.95	22.74	107	1	0	389.96	1.12
50	4,859	75	15.30	22.08	108	1	1	.	50
51	4,784	75	15.78	21.41	109				
52	4,709	77	16.40	20.75	110				
53	4,632	79	17.15	20.09	111				
54	4,553	83	18.02	19.43	112				
55	4,470	85	19.04	18.78	113				
56	4,385	89	20.20	18.13	114				
57	4,296	92	21.48	17.49					